constant coefficients. After the appearance of Fuchs's second memoir, many mathematicians, particularly in France and Germany, including Fuchs himself, took up the subject, which, though still in its infancy, now possesses a very large literature."

As happens in such cases, these memoirs have to be dug out of journals and publications of learned Societies before the student can be put in possession of results obtained. It is for this labour of research, and then for the arrangement in due sequence of theorems, that the reader has to thank Dr. Craig.[1] Even in the first two chapters, where most of the results are old, the treatment is comparatively new, being founded upon papers by Laguerre (*Comptes rendus*, 1879), and upon memoirs, or works, by Briot and Bouquet and Jordan; reference is also made, in connection with a proof by Jordan, to a paper by Picard (*Bulletin des Sciences Math.*, 1888). Here we may note that the author reserves an account of the investigations of Laguerre, Halphen, and others, from a still higher point of view, to a subsequent volume.

This first instalment discusses principally Fuchs's type of equations, but accounts are given of the researches of Frobenius (chapters iv., viii.), Markoff, Heun, Riemann, and Humbert (chapter vi.), Thomé (chapter ix.), Halphen (chapter xii.), Forsyth's canonical form and associate equations, Brioschi, Lagrange's adjoint equation, Halphen's adjoint quantics and Appell's theorem (chapter xiii.), and Picard (chapter xiv.). An account, due to Jordan, is given of the application of the theory of substitutions to linear differential equations (chapter iii.). Many points are touched lightly here, a fuller development being held in reserve. A prominent feature is the reproduction (chapter vii) of a thesis by M. E. Goursat on equations of the second order satisfied by the hypergeometric series. This consists of two parts. The first part gives an application of Cauchy's theorem, and relations between Kummer's (24) integrals, an application to the complete elliptic integral of the first kind, and Schwarz's results. The second part discusses the transformations of the hypergeometric series, Tannery's theorem, and some other points, the article closing with a collection of 137 transformations due (apparently) to Kummer.

The pages bristle with references to original sources, so that, as we have already indicated, this treatise is an invaluable handy-book to what has been done in this field.

One more word: there is no collection of examples for solution on the Cambridge model, but the work is strictly on the lines of a French or German treatise.

The book itself is very elegantly turned out.

THE BACTERIA OF ASIATIC CHOLERA.

The Bacteria of Asiatic Cholera. By E. Klein, M.D (London: Macmillan and Co., 1889.)

SO masterly and complete was the account which Koch gave in 1884 of the comma-bacillus, which he held to be the virus of cholera, that but little, if anything, has been added to our knowledge of its mode of growth, of its reaction to dyes, or of its life-history. As might be expected, the assiduity of many observers, now it has been directed to the subject, has led to the discovery of many other bacilli, which may be described as comma-shaped. But, so far, no bacteriologist, who has had his observations corroborated by other observers, has proved that any of them are indistinguishable in all their physical characters, whether in appearance, in reaction to dyes, or in their mode of growth, &c., from the choleraic bacillus. So far as is known, animals are not susceptible to cholera. If Asiatic cholera could be induced by inoculating with pure cultivations of choleraic comma-bacilli, then beyond a doubt they would be the *vera causa*, or, in other words, the contagium of cholera; but this step in Koch's argument was wanting, probably for the above-named reason, and is likely to remain so: the experimental inoculations of guinea-pigs which have taken place being by no means conclusive.

The present volume is a valuable and most trenchant criticism of every step of Koch's argument, and may be said to contain everything that can at present be said against Koch's theory, of which the author is the most active opponent.

The author commences with an account of the various comma-shaped bacilli which are at present known, and there are well-recognized characteristics which distinguish them from the first form, in all of them, except in those which depend upon solitary observations.

The following is the list of comma-shaped bacilli with the names of their discoverers:—

(1) Koch, in Asiatic cholera; $\frac{1}{2}$ to $\frac{2}{3}$ the length of tubercle bacilli, but thicker and curved. (2) Finkler and Prior, in cholera nostras; but Koch and Frank failed to demonstrate these in typical cases. They are thicker and longer than (1). In 10 per cent. gelatine, the growth is broad and conical, liquefying the gelatine more rapidly. (3) Lewis, in the fluid of the mouth, thicker than (1) Klein only twice has succeeded in growing them; every one else has failed. (4) Miller, in some cases of caries of the teeth, similar to (2). (5) Kuisl, in human fæces similar to (2). (6) Deneke, in stale cheeses. The growth on gelatine is similar, but they will not grow on potatoes. (7) Klein, in some cases of diarrhœa, especially in monkeys. They grow differetly in gelatine, and cause it to smell offensively. (8) Ermengen and others, in the intestines of guinea-pigs, pigs, rabbits, horses, &c., but they will not grow in 10 per cent. gelatine. (9) Lingard, two kinds in a case of noma, the smaller of which is said to have been very similar to the choleraic one. (10) Weibel, various forms in mucus, but their mode of growth is distinct. (11) Gamaleïa, in a fatal fowl disease, which was prevalent at Odessa. He did not distinguish them from (1). (12) Klein, in the intestines of a monkey with diarrhœa. The organisms were smaller, but the growth was similar to (1).

Klein lays great stress upon the difficulty there is in demonstrating the presence of the bacilli in the walls of the intestine in cases of cholera, and thinks that they are not present in the parts which are still alive, but only where the tissue has died; moreover they are absent from the blood.

The bacilli are most readily found in the mucous flakes; and in the presence of fæcal matter they are

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[1] For instance, he obtains certain forms in the same way that Fuchs obtained them, "if for no other reason than that of the desirability of developing the subject in historical order" (p. 64).

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readily destroyed, which may explain why they are sometimes not easily detected.

The author has done good service in threshing out all the evidence afresh, but the matter remains very much where Koch left it. The detection of the bacilli may enable us more readily to diagnose the earliest cases in an epidemic of cholera; and, as one result of his experiments, we may expect soiled linen to be most efficiently sterilized by drying it; at the same time, until the disease has been reproduced by inoculation with the organism, it cannot be said to be conclusively proved that this is the true virus.

OUR BOOK SHELF.

Manuel de l'Analyse des Vins. Par Ernest Barillot. Pp. xii–131. (Paris: Gauthier-Villars et Fils, 1889.)

THE student of practical chemistry will find in this book a handy guide to the examination of wines. Works on the same subject are frequently rendered both unwieldy and tiresome by a multiplicity of analytical methods and the introduction of a bulky collection of tables embodying the composition of various classes of wine, a knowledge of which is deemed necessary in forming an opinion of the quality or purity of a particular sample. Here, however, details of this kind are reduced to a minimum. One or two methods, only, of carrying out any estimation are given, and free use is made of such empirical relations between the proportions of the constituents of a wine as seem warranted by the results of previous analyses.

The book consists of two parts and an appendix. Part I. is concerned with the determination of the normal constituents of wines, alcohol, total solids, ash, grape sugar, &c. Part II. deals with adulterations. In its opening sections are placed the indications traceable to the presence of added water, added alcohol, cane sugar dextrine, &c., but the greater bulk of the part is devoted to the detection of foreign colouring matters. The subject of colour reactions is very fully treated, and by the arrangement of the experiments in tabular form their nature and interpretation can be readily appreciated. It seems a pity that in connection with these tests no notice is taken in the text of the absorption spectrum of the colouring agents, as a clue to their identification; in a footnote the author contents himself by merely referring the reader to the works of Vogel and Wurtz for information on this subject. In the appendix is a statement of the chemical constitution of the colouring matters mentioned, followed by an account of some recent work of the author on the detection of added alcohol. His method is based on the effect of the alcohol introduced on the proportion of volatile acid which distils from the wine, and the result is shown to be consistent with the theory of the rate of etherification of organic acids.

The book is intended to be useful for commercial purposes, and for such the analytical processes described are sufficiently accurate. The apparatus employed, as is stated in a footnote, has been constructed by the Société Centrale de Produits Chimiques, and judging from the illustrations, is in some cases, to English eyes at least, a trifle antiquated. The occasional reference to vessels provided with marks, and to which no numerical values are attached, detracts somewhat from the general usefulness of the book, and is unintelligible to a reader who has failed to notice the explanatory footnote.

The graduation of alcoholometers, the maximum amount of alcohol permissible in wines, &c., are of course in accordance with the regulations of the French Excise.

Synoptical Tables of Organic and Inorganic Chemistry. Compiled by Clement J. Leaper, F.C.S. (London: George Gill and Sons, 1890.)

THE compiler says in his preface that "the mass of facts presented to the mind of the beginner in chemistry is so large that he often experiences a difficulty in distinguishing the useful from the ornamental, and is apt, consequently, to neglect fundamental principles and reactions for comparatively useless minutiæ. These tables are intended to prevent this error. . . . The experience of many years has convinced the author that the student who honestly commits these tables to memory will lay for himself a solid groundwork for future reading and research." Whatever may be meant therefore by the expression "future reading and research," it appears that the compiler aims no higher than to give a series of unconnected statements which if learned will enable the would-be student to begin his study of chemistry. We do not think this committing to memory will make the study more easy, and should fear that the learner might imagine after his memory exercise that he thereby knew something of chemistry. The separation of "the useful from the ornamental" is always difficult, and it is rare to find two authorities at one in such a matter. It is doubtful, for example, whether any chemist will agree with the compiler when he states as Charles's law that "All gases expand or contract $\frac{1}{273}$ of their volume for each rise or fall of 1° C.," and omits, presumably as ornamental, the limitation of this proportion to the volume of the gas at 0° C.

The British Journal Photographic Almanac, 1890. Edited by J. Traill Taylor. (London: Henry Greenwood and Co., 1890.)

IN this year's volume we find a most interesting collection of notes and articles relating to almost every branch of the subject. Captain Abney contributes an article in which he warns photographers to beware of their principal enemy—dust—and concludes with the best method of exclusion. The Rev. S. J. Perry gives a short summary of the instruments used in celestial photography during the past year, and of the work accomplished, including the wonderful photographs taken by Isaac Roberts of the nebula of Andromeda, nebulæ in the Pleiades, &c. Mention is also made of the success of Mr. Common in rendering still more perfect the reflecting surface of his magnificent five-foot glass mirror. Amongst the other articles we may refer to that on halation by Chapman Jones, hydroquinone by W. B. Bolton, and celluloid films by Colonel J. Waterhouse. An epitome of the year's progress, with notes on passing events, original and selected, is given by the editor, who marks the great advance made in film photography, and also the tendency to diminish the bulk of cameras, as shown by the innumerable hand or detective cameras that have appeared during the last twelve months. Allusion also is made to the new developer, eikonogen, which can, it is believed, develop into full printing density a plate that has been impressed by feeble radiations.

No alteration has been made as regards the general order of the work; there are only slight additions to the tables, formulæ, &c. The specimens of processes which illustrate the volume, especially that of Mrs. Sterling from a negative by Vander Weyde, are very fine.

Four-Figure Mathematical Tables. By J. T. Bottomley, M.A., F.R.S., &c. Second Edition. (London: Macmillan and Co., 1890.)

THIS useful collection of tables has been considerably enlarged and revised since its first appearance. It comprises logarithmic and trigonometrical tables, tables of squares, square roots, and reciprocals, and a collection of useful formulæ and constants. The introduction is suffi-

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